

B.Tech III Year I Semester (R09) Supplementary Examinations December 2015

PRINCIPLES OF MACHINE DESIGN
 (Mechatronics)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions
 All questions carry equal marks

- 1 (a) Define the terms load, stress and strain. Discuss the various types of stresses and strain.
 (b) A shaft is transmitting 100 kW at 160 rpm. Find a suitable diameter for the shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress is 70 MPa.
- 2 (a) Explain the Soderberg method for combination stresses.
 (b) A machine component is subjected to a flexural stress which fluctuates between +300 MN/m² and -150 MN/m². Determine the value of minimum ultimate strength according to (i) Goodman relation. (ii) Soderberg relation. Take yield strength 0.55 ultimate strength; Endurance strength 0.5 ultimate strength; and factor of safety 2.
- 3 (a) What is the general classification of types of riveted joints?
 (b) A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are $\sigma_t = 120 \text{ MPa}$; $\tau = 100 \text{ MPa}$; $\sigma_c = 150 \text{ MPa}$. Find the efficiency of joint, taking the strength of the rivet in double shear as twice that of single shear.
- 4 (a) What do you understand by torsional rigidity and lateral rigidity?
 (b) A solid shaft is transmitting 1 MW at 240 rpm. Determine the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa.
- 5 (a) The extension springs are in considerably less use than the compression springs why.
 (b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm². Find the axial load which the spring can carry and the deflection per active turn.
- 6 (a) Explain the fast and loose pulley with the help of a neat sketch.
 (b) A leather belt 9 mm x 250 mm is used to drive a cast iron pulley 900 mm in diameter at 336 rpm. If active arc on the smaller pulley is 120° and the stress in tight side is 2 MPa, find the power capacity of the belt. The density of leather may be taken as 980 kg/m³ and the coefficient of friction of leather on cast iron is 0.35.
- 7 (a) Discuss the design procedure of spur gears.
 (b) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10000 rpm and has 80 mm pitch diameter. The gear has 320 mm pitch diameter, if the gears are made of cast steel having allowable static strength of 100 MPa. Determine a suitable module and face width from static strength considerations and check the gears for wear, given $\sigma_{es} = 618 \text{ MPa}$.
- 8 (a) Explain the types of bearings.
 (b) A 150 mm diameter shaft supporting a load of 10 kN has a speed of 1500 rpm. The shaft runs in a bearing whose length is 1.5 times the shaft diameter. If the diametral clearance of the bearing is 0.15 mm and absolute viscosity of the oil at the operating temperature is 0.111 kg/m-s, find the power wasted in friction.